



# Communication and Networking Riser Test Specification

**Revision 0.71**  
**May 9, 2001**

---

THIS SPECIFICATION IS PROVIDED "AS IS" WITH NO WARRANTIES WHATSOEVER, INCLUDING ANY WARRANTY OF MERCHANTABILITY, NONINFRINGEMENT, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY WARRANTY OTHERWISE ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE. Intel disclaims all liability, including liability for infringement of any proprietary rights, relating to use of information in this specification. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted herein.

This document is an intermediate draft for comment only and is subject to change without notice. Readers should not design products based on this document.

Copyright © Intel Corporation 2001.

\*Other names and brands may be claimed as property of others

## Table of Contents

<b>1. INTRODUCTION.....</b>	<b>5</b>
<b>2. TEST COVERAGE .....</b>	<b>6</b>
2.1. RISER CARD FEATURES.....	6
2.2. MOTHERBOARD FEATURES .....	6
2.3. VALID CNR/MOTHERBOARD COMBINATIONS .....	6
<b>3. REFERENCE DOCUMENTS .....</b>	<b>7</b>
<b>4. TEST METHODOLOGY .....</b>	<b>8</b>
<b>5. HARDWARE REQUIREMENTS.....</b>	<b>9</b>
5.1. RISER CARD TESTING.....	9
5.2. MOTHERBOARD TESTING .....	9
<b>6. SOFTWARE REQUIREMENTS .....</b>	<b>10</b>
<b>7. TEST ASSERTIONS .....</b>	<b>11</b>
7.1. MOTHERBOARD ASSERTIONS.....	11
7.1.1. <i>System BIOS Assertions</i> .....	11
7.1.2. <i>Motherboard AC Link Demotion Assertions</i> .....	13
7.1.3. <i>Motherboard Audio Multi-Channel Assertions</i> .....	13
7.1.4. <i>Motherboard Assertions Not Tested</i> .....	13
7.2. RISER ASSERTIONS.....	14
7.2.1. <i>General Riser PnP EEPROM Assertions</i> .....	14
7.2.2. <i>LAN Riser PnP EEPROM Assertions</i> .....	15
7.2.3. <i>SMBus Riser PnP EEPROM Assertions</i> .....	15
7.2.4. <i>USB Riser PnP EEPROM Assertions</i> .....	16
7.2.5. <i>AC Link Riser Assertions</i> .....	16
7.2.5.1. <i>Modem Specific PnP EEPROM Assertions</i> .....	17
7.2.5.2. <i>Audio Specific PnP EEPROM Assertions</i> .....	17
7.2.5.3. <i>Riser Demotion Specific Assertions</i> .....	18
<b>8. TEST DESCRIPTIONS.....</b>	<b>19</b>
8.1. CNR PNP EEPROM CONSISTENCY TEST (EECONTST.EXE).....	19
8.1.1. <i>Generic Riser PnP EEPROM Consistency Test Description</i> .....	19
8.1.1.1. <i>Setup</i> .....	19
8.1.1.2. <i>Interpretation of Results</i> .....	20
8.1.1.3. <i>Test Algorithm</i> .....	20
8.1.2. <i>Riser LAN EEPROM Consistency Test Description</i> .....	21
8.1.2.1. <i>Setup</i> .....	21
8.1.2.2. <i>Interpretation of Results</i> .....	21
8.1.2.3. <i>Test Algorithm</i> .....	22
8.1.3. <i>Riser SMBus EEPROM Consistency Test Description (Optional)</i> .....	22
8.1.3.1. <i>Setup</i> .....	23
8.1.3.2. <i>Interpretation of Results</i> .....	23
8.1.3.3. <i>Test Algorithm</i> .....	23
8.1.4. <i>USB Riser EEPROM Consistency Test Description</i> .....	23
8.1.4.1. <i>Setup</i> .....	24
8.1.4.2. <i>Interpretation of Results</i> .....	24
8.1.4.3. <i>Test Algorithm</i> .....	24
8.1.5. <i>Riser AC Link EEPROM Consistency Test</i> .....	24
8.1.5.1. <i>Setup</i> .....	25
8.1.5.2. <i>Interpretation of Results</i> .....	25

8.1.5.3.	Test Algorithm .....	26
8.1.6.	<i>Riser AC Link Demotion and Multi Channel Audio Test</i> .....	26
8.1.6.1.	Setup.....	26
8.1.6.2.	Interpretation of Results .....	27
8.1.6.3.	Test Algorithm .....	28
8.2.	MOTHERBOARD BIOS EEPROM VALIDATION SUPPORT TEST .....	28
8.2.1.1.	Setup.....	29
8.2.1.2.	Interpretation of Results .....	29
8.2.1.3.	Test Algorithm .....	29
8.3.	MOTHERBOARD AC LINK TEST .....	29
8.3.1.	<i>Setup</i> .....	30
8.3.2.	<i>Interpretation of Results</i> .....	31
8.3.2.1.	The test <i>fails</i> if:.....	31
8.3.2.2.	The test <i>aborts</i> if:.....	32
8.3.3.	<i>Test Algorithm</i> .....	32
8.4.	MOTHERBOARD AC LINK DEMOTION.....	32
8.4.1.	<i>Setup</i> .....	32
8.4.2.	<i>Interpretation of Results</i> .....	33
8.4.2.1.	The test <i>fails</i> if:.....	33
8.4.2.2.	The test <i>aborts</i> if:.....	34
8.4.3.	<i>Test Algorithm</i> .....	34
8.5.	MOTHERBOARD MULTI CHANNEL SIGNATURE TEST .....	35
8.5.1.	<i>Setup</i> .....	35
8.5.2.	<i>Interpretation of Results</i> .....	36
8.5.2.1.	The test <i>fails</i> if:.....	36
8.5.2.2.	The test <i>aborts</i> if:.....	37
8.5.3.	<i>Test Algorithm</i> .....	37
8.6.	MOTHERBOARD BIOS LAN CAPABILITY TEST .....	37
8.6.1.	<i>Setup</i> .....	38
8.6.2.	<i>Interpretation of Results</i> .....	38
8.6.2.1.	The test <i>fails</i> if:.....	38
8.6.2.2.	The test <i>aborts</i> if:.....	39
8.6.3.	<i>Test Algorithm</i> .....	39
8.7.	MOTHERBOARD BIOS USB CAPABILITY TEST.....	39
8.7.1.	<i>Setup</i> .....	39
8.7.2.	<i>Interpretation of Results</i> .....	39
8.7.2.1.	The test <i>aborts</i> if:.....	40
8.7.3.	<i>Test Algorithm</i> .....	40
9.	<b>GLOSSARY</b> .....	41
10.	<b>APPENDIX A - TEST CONFIGURATION MATRIX</b> .....	42
11.	<b>APPENDIX B - TEST COVERAGE MATRICES</b> .....	43
11.1.	LAN TEST COVERAGE MATRIX .....	43
11.2.	USB TEST COVERAGE MATRIX .....	43
11.3.	AC LINK TEST COVERAGE MATRIX.....	44

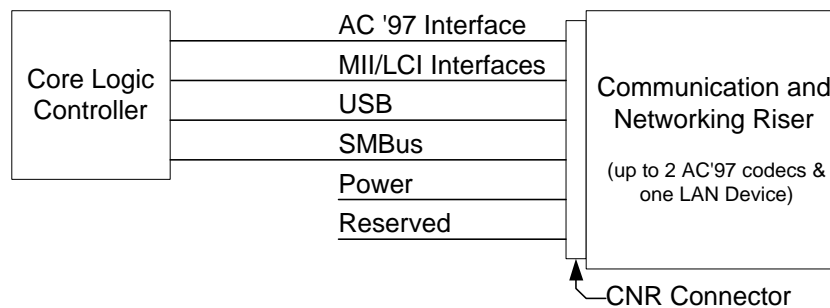
## Revision History

Revision 0.70	4/30/2001	Initial Technical Review complete
Revision 0.71	5/09/2001	Legal approved

## 1. Introduction

The Communication and Networking Riser (CNR) Specification defines a hardware scalable Original Equipment Manufacturer (OEM) motherboard riser and interface that supports the audio, modem, local area network (LAN), Universal Serial Bus (USB), and System Management Bus (SMBus) interfaces of core logic chipsets.

This document describes tests that determine hardware compliance with requirements for CNR cards and motherboards described in the reference documents listed below. While a wide range of CNR combinations are considered, the coverage may not be complete at this time. A CNR Test Suite will soon be available which is written to this specification. Comments are welcome thru the CNR website at <http://developer.intel.com/technology/cnr/index.htm> or sending email to [cnr.support@intel.com](mailto:cnr.support@intel.com).



Currently, five interfaces are supported on CNR. The Media Independent Interface (MII) or the LAN Connect Interface (LCI) can be used for LAN, thus, allowing a maximum of four interfaces on a given CNR card.

A description of the interfaces are listed below:

- System Management Bus (SMBus) - Provides Plug and Play (PnP) functionality for the CNR card.
- AC '97 Interface - Supports audio and modem functions on the CNR card.
- LAN Connect Interface (LCI) - Provides LAN and Home Phone Networking Alliance (HPNA) capabilities for Intel chipset based solutions (refer to the CNR specification).
- Media Independent Interface (MII) - Provides 10/100 switching and/or HPNA for CNR platforms using the MII Interface.
- Universal Serial Bus (USB) - Supports devices implemented with a USB interface.

Operating systems have improved dramatically through the past several years in their ability to use standardized register space to uniquely identify hardware added to a system and to appropriately install the driver(s) intended for the newly installed hardware. To insure that the same level of automation and that ease-of-use is maintained, the CNR shall implement a Plug-and-Play (PnP) type interface that is compatible with today's operating systems. The CNR PnP information will be provided to the operating system using a combination of a SMBus based EEPROM and system BIOS routines. The electrical interface to the EEPROM is provided on the CNR connector through the signals SMB\_SCL, SMB\_SDA, SMB\_A2, SMB\_A1 and SMB\_A0.

## **2. Test Coverage**

### **2.1. Riser Card Features**

The peripherals covered are all valid CNR card configurations including one or more of the following:

- V.90 Modem
- Audio
- LAN 10/100 Platform LAN Connection (PLC)
- Home Phone line Network Association (HPNA) PLC
- MII-based Phy
- Audio/Modem Codec (AMC)
- USB Ports

Various PC2001 compliant motherboards will be combined with the CNR cards under test.

### **2.2. Motherboard Features**

Motherboard configuration coverage include all valid down device and routing combinations per Communication and Network Riser Specification v1.1 which include:

- PLC down (on motherboard)
- PLC routed (no PLC down)
- PLC and MII not routed
- MII-based PHY down
- MII routed (no MII down)
- USB 1.1 routed
- USB not routed
- AC Link routed, no AC link codecs down
- AC Link routed, Audio only down
- AC Link routed, V.90 Modem only down
- AC Link routed, AMC down
- AC Link routed, Audio and V.90 Modem down

Various valid and invalid CNR cards will be combined with the motherboards under test.

### **2.3. Valid CNR/Motherboard Combinations**

See the configuration matrix in Appendix A for various combinations used during testing.

Valid and Invalid combinations of CNR and motherboards can be seen in Appendix B. Note that LAN, USB and AC Link are all independent interfaces; therefore, combinations of LAN, USB, and AC Link will be treated for test purposes as separate risers even when they co-exist physically on a single riser.

### **3. Reference Documents**

- Communication and Networking Riser Specification, Revision 1.1.
- System Management Bus Specification, Revision 1.1.
- Audio Codec '97 Component Specification, Revision 2.1.
- Universal Serial Bus Specification, Revision 1.1.
- PCI BIOS Specification, Revision 2.3.
- Communication and Network Riser System Design Guidelines, Version 1.0.
- Recommendations for Implementing a CNR Card using the Media Independent Interface (MII) White Paper, November 2000

## 4. Test Methodology

This test focuses on the SMBus based Plug and Play (PnP) EEPROM requirements of the CNR cards as well as the system BIOS requirements of the CNR motherboards per the referenced specifications. The tests use an SMBus driver to access the contents of the Plug and Play (PnP) EEPROM. Part of the testing is automated, part is manual, requiring a sequence of warm and/or cold reboots. Testing is divided into motherboard tests concentrating on system BIOS and riser tests centered on EEPROM programming.

**NOTE: The CNR PnP EEPROM test requires the SMBus be readable and writeable after the BIOS finishes initializing the system and hands control over to the OS. The tests access the SMBus under various Windows operating systems as well as DOS/EFI.**

Both positive and negative test assertions will be covered. Positive test assertions look for a good outcome for the unit under test with a known good (valid) configuration. Negative test assertions induce a known error condition and test to ensure that the unit under test handles the adverse condition per specification. CNR cards will be predominately tested with positive test assertions. System BIOS testing is more evasive, using both positive and negative test assertions to ensure that the motherboard will handle incompatible and invalid CNR card combinations.

In negative test assertions, to decrease the number of CNR cards required for testing, the writes are performed to the CNR card's PnP EEPROM to force errors on the next reboot. To this end, the SMBus shall be accessible and the EEPROM writeable. Note that the contents of the EEPROM will be saved before the negative test and then restored afterwards.

Some of the test routines are the same for both motherboard and CNR card testing. The depending upon the context of positive or negative assertions and which is the unit under test will dictate interpretation of results.



## 5. Hardware Requirements

### 5.1. Riser Card Testing

It is required that the tests be executed on PC 2001 compliant systems that may include the following types of valid hardware features. Hardware needed depends upon the riser card being tested.

1. PLC down
2. PLC routed
3. MII PHY routed but not down
4. USB routed
5. No USB routed
6. No AC Link down but routed
7. Single Audio Codec Down
8. Single AMC Down
9. Single Modem Codec Down
10. Audio & Modem Codecs (2) Down

The following is a minimal list of motherboards that could be used. This list may change in the future.

- A. Motherboard combining features 1 & 5 & 7 (EA815E or similar motherboard board ) Intel-based PLC down, without USB routed to the connector and with an Audio Codec down.
- B. Motherboard combining features 2 & 4 & 6 Intel-based PLC routed but not down, with USB routed, without any AC Link Codecs down
- C. Motherboard with feature 10
- D. Motherboard with feature 3
- E. Motherboard with feature 8
- F. Motherboard with feature 9

For riser card testing of optional multi-channel upgrade audio, the riser card vendor will provide a PC2001 compliant system that includes a matching audio solution and correct system BIOS support.

### 5.2. Motherboard Testing

Motherboard testing is performed with PC 2001 compliant riser cards. These cards will be used in both positive assertion and negative assertion testing. Hardware needed depends upon the motherboard configuration being tested.

1. LAN 10/100 PLC Riser
2. MII-based PHY
3. Riser with USB
4. Modem only riser
5. Audio Codec (no other AC Link devices)
6. AMC with no other AC Link devices
7. Audio & Modem (2 Codec Riser)

For motherboard testing of optional multi-channel upgrade audio capability, the motherboard vendor shall provide a compliant riser card that includes a matching audio solution.

## **6. Software Requirements**

All CNR tests execute directly from a Windows application and use the standard Windows operating system features. Windows\* 2000, Windows\* ME, and Windows\* Whistler are required. Other general software requirements of PC2001 Specification shall be met for the test suite to properly execute.

Localization is not supported by this test.

## 7. Test Assertions

Assertions are divided into motherboard and riser statements. This section details assertions, includes cross-references to the CNR specification and name of the test that incorporates each assertion. Test descriptions for each test are located in following sections.

### 7.1. Motherboard Assertions

This test requires a manual interaction for verification of the message during POST. This test requires automated assertions on disabling. Revamp test names (with Jehan/Phillip).

#### 7.1.1. System BIOS Assertions

- 1.1.1 If the calculated and extracted checksum values do not match, the BIOS shall display the following message ***“CNR Plug-and-Play EEPROM contents are damaged. CNR cards will be ignored. Press F1 to Resume.”***  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.2.  
**Test description:** MBVALTST.exe
- 1.1.2 If the calculated and extracted checksum values do not match, the BIOS shall disable the functions associated with the CNR card.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.2.  
**Test description:** MBVALTST.exe
- 1.1.3 If the CNR card version is greater than the BIOS CNR version, the BIOS shall display the following message: ***“CNR version newer than motherboard. Some CNR functionality may be lost. Press F1 to Resume.”***  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.3.  
**Test description:** MBVALTST.exe
- 1.1.4 If the CNR card AC’97 Version is not the same as the BIOS AC’97 Version number then the BIOS shall display the following message: ***“BIOS not compliant with the AC’97 devices on CNR. AC’97 functionality of CNR disabled. Press F1 to Resume.”***  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.4.  
**Test description:** MBVALTST.exe
- 1.1.5 If the CNR card AC ‘97 Version is not the same as the BIOS AC ’97 Version number then the BIOS shall disable the audio and/or the modem functions of the AC ’97 controller function(s).  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.4.  
**Test description:** MBVALTST.exe
- 1.1.6 When the CNR card installed contains interfaces that are not supported by the motherboard routing, the BIOS shall display the appropriate message to the user.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.5.  
**Test description:** Multiple
- 1.1.7 If the BIOS is unable to supply the minimum USB compliance version required to support the USB devices or functions of the CNR, the BIOS shall display the message. ***“BIOS not compliant with USB devices on CNR”***  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.7.  
**Test description:** MBVALTST.exe

- 1.1.8 If the BIOS is unable to supply the minimum USB compliance version required to support the USB devices of the CNR, the BIOS shall disable USB controllers routed to the CNR connector.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.7.  
**Test description:** MBVALTST.exe
- 1.1.9 If the USB version required by the CNR is greater than supported by the motherboard then the BIOS shall display the message. ***“USB version required by the CNR is not supported by motherboard. The CNR USB function will operate at a lower speed. Press F1 to continue.”***  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.7.  
**Test description:** MBVALTST.exe
- 1.1.10 If the LAN interface required by the CNR board is not the same as the LAN interface provided by the motherboard then the BIOS shall display the following message: ***“CNR LAN Interface not compatible with Motherboard LAN Interface. LAN Function has been disabled. Press F1 to resume.”***  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.8.  
**Test description:** MBVALTST.exe
- 1.1.11 If the LAN interface required by the CNR board is not the same as the LAN interface provided by the motherboard, then the BIOS shall disable the LAN function.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.8.  
**Test description:** MBVALTST.exe
- 1.1.12 If the LAN interface version supported by the CNR card is higher than the system BIOS understands, the BIOS shall display the following message during POST: ***“BIOS not compliant with CNR LAN devices. LAN Function has been disabled. Press F1 to resume.”***  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.8.  
**Test description:** MBVALTST.exe
- 1.1.13 If the LAN interface version supported by the CNR card is higher than the system BIOS understands, the BIOS shall disable the LAN function.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.8.  
**Test description:** MCVALTST.exe
- 1.1.14 For any valid motherboard/CNR configuration, when an Audio Codec is present on the CNR only, the System BIOS shall program the Audio PCI configuration space SVID and SSID registers per CNR PnP EEPROM.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.6.3.1.  
**Test description:** MBACLINK.exe
- 1.1.15 For any valid motherboard/CNR configuration, when a Modem Codec is present on the CNR, the System BIOS shall program the Modem PCI configuration space SVID and SID registers per CNR PnP EEPROM.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.2.6.3.1.  
**Test description:** MBACLINK.exe
- 1.1.16 For any valid motherboard/CNR configuration, when a LAN (PLC, HPNA, or MII PHY) is present on the CNR, the System BIOS shall program the proper PCI configuration space SVID and SID registers per CNR PnP EEPROM.

**Reference document:** *CNR Specification*, Revision 1.1, Section 6.2.8.

**Test description:** MBLANTST.exe

### 7.1.2. Motherboard AC Link Demotion Assertions

- 1.10.1 When a motherboard has a down codec, the motherboard will provide a 10K ohm pull down resistor on the CDC\_DN\_ENAB# signal and needed support circuitry to allow the onboard codec to be disabled if a multi-codec CNR is installed.

**Reference document:** *CNR Specification*, Revision 1.1, Section 3.3.1.2.

**Test description:** MBACLINK.exe

- 1.10.2 When two or more codecs are present, the system BIOS shall determine if there are any illegal primary/secondary combinations, alert the user, and disable the associated functions.

**Reference document:** *CNR Specification*, Revision 1.1, Section 3.3.1.1.

**Test description:** MBACLINK.exe

### 7.1.3. Motherboard Audio Multi-Channel Assertions

- 1.11.1 CNR and on the motherboard, the System BIOS shall verify the multi channel audio signatures and if they match, will program the Audio PCI configuration space SVID and SIDs register per CNR PnP EEPROM.

**Reference document:** *CNR Specification*, Revision 1.1, Section 6.2.6.3.1.

**Test description:** MBACLINK.exe

- 1.11.2 When an Audio Codec is on the CNR and on the motherboard, the System BIOS shall verify the multi channel audio signatures and if they do not match, will display the error “**CNR Multi-channel Audio Upgrade not compatible with motherboard. Audio Function has been disabled. Press F1 to Resume**”.

**Reference document:** *CNR Specification*, Revision 1.1, Section 6.2.6.3.1.

**Test description:** MBACLINK.exe

- 1.11.3 When an Audio Codec is on the CNR and on the motherboard, the System BIOS shall verify the multi channel audio signatures and if they do not match, will disable the audio functions on the motherboard.

**Reference document:** *CNR Specification*, Revision 1.1, Section 6.2.6.3.1.

**Test description:** MBACLINK.exe

- 1.11.4 When CDC\_DN\_ENAB# is low, more than one audio codec is present, the audio codecs are from the same manufacturer, and the CNR multi-channel signature does not match the motherboard multi-channel signature, the system BIOS will disable the AC'97 audio function and display the appropriate error message to the user during POST.

**Reference document:** *CNR Specification*, Revision 1.1, Section 6.2.6.3.1.

**Test description:** MBACLINK.exe

### 7.1.4. Motherboard Assertions Not Tested

The following assertions are not tested.

- 1.2.1 Motherboard shall support power management for CNR cards.

**Reference document:** *CNR Specification*, Revision 1.1, Section 7.1(3).

**Test description:** “N/A”

- 1.2.2 Motherboard shall not support more than a single CNR connector.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 7.1(3).  
**Test description:** “N/A”
- 1.2.3 CNR connector shall be placed in the left-most slot location and share the I/O bracket space with the adjacent PCI slot (or AGP).  
**Reference document:** *CNR Specification, Revision 1.1*, Section 7.1(3).  
**Test description:** “N/A”
- 1.2.4 Motherboard shall not simultaneously support both an audio/modem (AMR) and a CNR connector.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 7.1(3).  
**Test description:** “N/A”

## 7.2. Riser Assertions

### 7.2.1. General Riser PnP EEPROM Assertions

The test assertions derived for CNR PnP EEPROM are covered in this section.

**NOTE: The CNR PnP EEPROM test requires the SMBus be readable and writeable after the BIOS finishes initializing the system and hands control over to the OS. The tests access the SMBus under various Windows operating systems as well as DOS/EFI.**

- 1.3.1 CNR cards shall be compatible with System Management Bus (SMBus) Specification Revision 1.1.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.1.1.  
**Test description:** EECONTST.exe
- 1.3.2 All CNR Cards shall support CNR PnP EEPROM Detection.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.1.1.  
**Test description:** EECONTST.exe
- 1.3.3 CNR card shall contain a compliant EEPROM ID register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.1.  
**Test description:** EECONTST.exe
- 1.3.4 CNR card shall contain a CNR 1.1 compliant EEPROM size register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.2.  
**Test description:** EECONTST.exe
- 1.3.5 CNR card shall support at least CNR specification, Revision 1.1 or higher.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.3.  
**Test description:** EECONTST.exe
- 1.3.6 CNR card shall contain a CNR 1.1 compliant Function ID register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.5.  
**Test description:** EECONTST.exe
- 1.3.7 CNR card shall contain CNR 1.1 compliant reserved registers.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.6.  
**Test description:** EECONTST.exe

- 1.3.8 CNR card shall contain CNR 1.1 compliant Reserved pointer registers.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.12.  
**Test description:** EECONTST.exe
- 1.3.9 CNR card shall contain a CNR 1.1 compliant Last Valid Address register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.13.  
**Test description:** EECONTST.exe
- 1.3.10 CNR card shall contain a CNR 1.1 compliant Checksum register  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.14.  
**Test description:** EECONTST.exe

### 7.2.2. LAN Riser PnP EEPROM Assertions

The test assertions derived for LAN risers are covered in this section. In addition to the general riser PnP EEPROM assertions, the following assertions apply to CNR card with LAN (PLC, HPNA, or MII):

- 1.4.1 A LAN capable CNR card shall have the Function ID register LAN flag, bit 4, set to 1.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.5.  
**Test description:** EECONTST.exe
- 1.4.2 A LAN capable CNR shall contain a non-zero CNR 1.1 compliant LAN pointer register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.5.  
**Test description:** EECONTST.exe
- 1.4.3 A LAN capable CNR card shall contain a CNR 1.1 compliant LAN Option Register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.7.1.  
**Test description:** EECONTST.exe
- 1.4.4 A LAN capable CNR card shall have the LAN CNR Vendor ID programmed to a non-zero value.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.7.2.  
**Test description:** EECONTST.exe
- 1.4.5 A LAN capable CNR card shall have the LAN CNR Model ID programmed to a non-zero value.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.7.3.  
**Test description:** EECONTST.exe
- 1.4.6 A LAN capable CNR card incorporating LAN shall have the LAN Compliance register programmed the correct value for the incorporated LAN interface.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.7.4.  
**Test description:** EECONTST.exe

### 7.2.3. SMBus Riser PnP EEPROM Assertions

In addition to the general riser PnP EEPROM assertions, the following assertions apply to CNR card for the SMBus interface:

- 1.5.1 CNR card shall contain a CNR compliant Function ID register with the SMBus flag, bit 3, set to 1.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.5.

**Test description:** EECONTST.exe

- 1.5.2 If the SMBus Pointer is a non-zero value, the SMBus compliance register shall be a non-zero value.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.5.

**Test description:** EECONTST.exe

- 1.5.3 If the SMBus Pointer is a non-zero value, the SMBus reserved register space shall be 0x00000000.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.5.

**Test description:** EECONTST.exe

## 7.2.4. USB Riser PnP EEPROM Assertions

The test assertions derived for USB risers are covered in this section. In addition to the general riser PnP EEPROM assertions, the following assertions apply:

- 1.6.1 A USB capable CNR card shall contain a CNR compliant Function ID register with USB flag, bit 2, shall be set to 1.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.9.

**Test description:** EECONTST.exe

- 1.6.2 A USB capable CNR card shall contain a non-zero USB pointer register.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.

**Test description:** EECONTST.exe

- 1.6.3 On USB capable CNR cards, if the USB pointer is a non-zero value, the USB Option register shall be set to a valid value. A valid value contains SPD bits set to a value of 0 or 1, reserved bits equal to 0x0000, and appropriate Hub and Wake bit values which are card dependent.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.1.

**Test description:** EECONTST.exe

- 1.6.4 On USB capable CNR cards, if the USB Pointer is a non-zero value, the USB Compliance register shall be set to 0x0100 indicating the card supports at least USB Specification 1.0 or later.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.

**Test description:** EECONTST.exe

## 7.2.5. AC Link Riser Assertions

The test assertions derived for AC Link capable riser testing are covered in this section. Assertions for Modem and Audio risers apply to AMC capable risers. In addition to the general riser PnP EEPROM assertions, the following assertions apply:

- 1.7.1 An AC Link capable CNR card shall support AC'97 specification, Revision 2.1 or later.

**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.4

**Test description:** EECONTST.exe



#### 7.2.5.1. Modem Specific PnP EEPROM Assertions

- 1.7.2 A Modem capable CNR card shall contain a CNR compliant Function ID register with MODEM flag, bit 1, shall be set to 1.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.2.5.  
**Test description:** EECONTST.exe
- 1.7.3 Modem capable CNR card shall contain a non-zero Modem pointer register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.  
**Test description:** EECONTST.exe
- 1.7.4 On Modem capable CNR cards, if the Modem pointer is a non-zero value, the Modem Vendor ID register shall be set to a valid value.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.1.  
**Test description:** EECONTST.exe
- 1.7.5 On Modem capable CNR cards, if the Modem Pointer is a non-zero value, the Modem Model ID register shall be set to a valid value.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.  
**Test description:** EECONTST.exe

#### 7.2.5.2. Audio Specific PnP EEPROM Assertions

- 1.7.6 Audio capable CNR cards shall contain a CNR compliant Function ID register with Audio flag, bit 0, shall be set to 1.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.  
**Test description:** EECONTST.exe
- 1.7.7 Audio capable CNR card shall contain a non-zero Audio pointer register.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.  
**Test description:** EECONTST.exe
- 1.7.8 On Audio capable CNR cards, if the Audio pointer is a non-zero value, the Audio CNR Vendor ID register shall be set to a valid value.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.  
**Test description:** EECONTST.exe
- 1.7.9 On Audio capable CNR cards, if the Audio Pointer is a non-zero value, the Audio CNR Model ID register shall be set to a valid value.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.  
**Test description:** EECONTST.exe
- 1.7.10 On Audio capable CNR cards which are designated as upgrade cards for existing motherboard audio codecs, the Audio Multi-Channel Signature register shall be set to a valid non-zero value. This assertion is optional.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.  
**Test description:** EECONTST.exe
- 1.7.11 On Audio capable CNR cards which are designated as upgrade cards for existing motherboard audio codecs, the Audio Multi-Channel Model ID register shall be set to a valid non-zero value. This assertion is optional.  
**Reference document:** *CNR Specification, Revision 1.1*, Section 6.1.5.2.  
**Test description:** EECONTST.exe

### 7.2.5.3. Riser Demotion Specific Assertions

- 1.7.12 When a CNR card contains two codecs, the CNR shall disable all onboard codecs by holding the onboard codecs in reset via a strong pull-up (1K ohm) resister on the CDC\_DN\_ENAB# signal.

**Reference document:** *CNR Specification, Revision 1.1*, Section 3.3.1.2.

**Test description:** EECONTST.exe

- 1.7.13 When a CNR card contains a single codec, it shall allow onboard codecs to be primary by providing a weak pull-up (100K ohm) resister on the CDC\_DN\_ENAB# signal.

**Reference document:** *CNR Specification, Revision 1.1*, Section 3.3.1.2.

**Test description:** EECONTST.exe

## 8. Test Descriptions

This section includes an overview of each test, hardware and software setup, execution instructions, and test results interpretation.

### 8.1. CNR PnP EEPROM Consistency Test (EECONTST.exe)

#### 8.1.1. Generic Riser PnP EEPROM Consistency Test Description

This test portion of the test will be executed every time the EECONTST is called.

The following assertions are tested: 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5, 1.3.7, 1.3.8, 1.3.14, 1.3.15, and 1.3.16. Individual interface tests are detailed in following sections.

The CNR card contains an EEPROM whose address and data lines are routed to the CNR slot. The motherboard will contain an SMBus controller whose data lines are routed to the CNR connector. The three CNR connector's address lines will be hardwired to provide a unique SMBus address. The most significant nibble shall be hard-wired to 1010b (0xA). The least significant nibble will consist of 4 bits, the least significant bit means be the read (even address) or write (odd address) while the next 3 will contain the address lines of the CNR card (SMB2, SMB1, SMB0). The CNR PnP EEPROM shall have a unique address on the SMBus, i.e. unlike any other EEPROMs on the motherboard, like DIMM slots' address.

After reading the CNR EEPROM data from the SMBus address range from (0xA0-0xAE), the data will be parsed byte-wise per the CNR Specification. The following offsets will be examined:

Register Name	Offset	Bit	Expected Value
EEPROM ID	0x00	15:0	0x9249
EEPROM Size	0x02	15:0	0x5 < x < 0x9. See Note 1
CNR Compliance	0x04	15:0	0x0100 or 0x0110. See Note 2
Function ID	0x08	15:5	0x0000
Function ID	0x08	4:0	If the Function ID register indicates that a function is not implemented, the corresponding pointer register will be set to 0x0000. When function bits 4 to 0 are non-zero, that function's pointer register is non-zero, bit 3 shall always be set to 1 indicating the SMBus interface is supported (for the PnP EEPROM)
Reserved Space	0x0A, 0x0C 0x18 to 0x2C	15:0	All reserved bytes per CNR compliance are programmed to 0x0000
Last Valid Address	0x2E	15:0	Shall contain the last valid non-zero byte in the EEPROM.
Checksum	0x30	15:0	Shall contain a valid running sum of all bytes within the PnP EEPROM excluding itself

Note 1: There is at least 0x30h (48d) bytes in the EEPROM since the highest defined required byte is the checksum byte. Per the table the next highest value equates to 64 bytes. The EEPROM size register value shall be greater than or equal to 0x0006. At this time, certain chipsets cannot handle EEPROMs that are greater than 256 bytes; therefore, EEPROMs with sizes greater than 256 bytes are failures.

Note 2: As the CNR specification evolves, the CNR compliance register allowed values will change to match latest specification.

##### 8.1.1.1. Setup

This test can be run with any valid combination of any CNR motherboard and riser cards. The valid CNR Motherboard shall have all memory slots populated to test if the PnP EEPROM SMBus addresses overlap with any SMBus address of Serial Presence Detect EEPROMs of memory modules.

### 8.1.1.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

#### 8.1.1.2.1. The test *fails* if:

- CNR EEPROM device does not support SMBus Specification Revision 1.1
- CNR EEPROM size register value is less than 64 bytes
- CNR EEPROM size register value is greater than 256 bytes
- CNR card does not support at least CNR specification, Revision 1.0
- The bits 15 through 5 of the Function ID register are programmed to non zero values
- The SMB bit (bit 3) of the Function ID register is not set
- The reserved registers are not programmed to zero.
- The Last Valid Address Register is not the last word offset in the EEPROM that contains valid data.
- The Checksum register value is not same as the value that contains a running sum of all bytes within the PnP EEPROM device, excluding the checksum register

#### 8.1.1.2.2. The test *aborts* if:

- No CNR card or NO CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

### 8.1.1.3. Test Algorithm

The Riser PnP EEPROM Consistency test (EECONTST) addresses CNR compliance of the PnP EEPROM by verifying the contents of the CNR EEPROM master configuration space register map.

The EECONTST test performs the following steps:

1. Check for presence of the CNR EEPROM data at the SMBus address range 0x0a0-0x0ae.
2. Copy the CNR EEPROM data to local memory by reading the data one byte at a time.
3. Verify that the EEPROM ID register, located at offset 0x00 of the EEPROM data, contains the value 0x9249.
4. Verify that the EEPROM size register, located at offset 0x02 of the EEPROM data, contains a value corresponding to a size between 64 and 256 bytes inclusive.
5. Verify that the CNR compliance register indicates CNR specification revision 1.0 or greater.
  - a. Read the contents of the CNR compliance register, located at offset 0x04 of the EEPROM data.
  - b. Format the two bytes of the CNR compliance register into a single value and verify the value indicates CNR specification revision 1.0 or greater.
6. Verify that the CNR card contains a CNR-compliant function ID register.
  - a. Read the contents of the CNR function ID register, located at offset 0x08 of the EEPROM data.
  - b. Verify bits 5 through 15 contain the value 0.
  - c. Verify the SMB bit (bit 3) contains the value 1.
7. Verify that the reserved registers, located at offsets 0x0a and 0x0c of the EEPROM data, contain the value 0.
8. Verify that the SMBus pointer register, located at offset 0x14 of the EEPROM data, contains the value 0.
9. Verify that the reserved pointer registers, located at offsets 0x18 through 0x2c of the EEPROM data, contain the value 0.
10. Verify that the CNR card contains a CNR-compliant checksum register.

- a. Read the value of the CNR checksum register, located at offset 0x14 of the EEPROM data.
  - b. Compute the checksum by adding all bytes within the EEPROM device, excluding the CNR checksum register, and ignoring the carry from the 16<sup>th</sup> to the 17<sup>th</sup> bit.
  - c. Verify that the computed checksum value matches the contents of the CNR checksum register.
11. Verify that the CNR card contains a CNR-compliant Last Valid address register.
- a. Read the value of the last valid address register, located at offset 0x2E of the EEPROM data.
  - b. Locate the last valid address by scanning all bytes, starting from the upper most byte indicated by the size register backwards toward offset 0x00, for the last register with a value not equal to 0xFF.
  - c. Verify that the last valid address value matches the last location of the last non-0xFF byte value.

### 8.1.2. Riser LAN EEPROM Consistency Test Description

This portion of the test will be executed when the "-L" or "-I" command line options are used on the EECONTST.exe executable.

The following assertions are tested: 1.4.1 to 1.4.6

After reading the CNR EEPROM data from the SMBus address range from (0xA0-0xAE), the data will be parsed byte-wise per the CNR Specification. If LAN is incorporated onto the CNR card, beyond the tests described in the General Riser PnP EEPROM Test, the following will be tested.

Register Name	Offset	Bit	Expected Value
Function ID	0x08	4	0x01 for all LAN riser cards
LAN Pointer	0x16	15:0	When LAN is incorporated, Non Zero value pointing to valid LAN Option register for that card. This value is the LP value. When LAN is not incorporated, this register is 0x0000
LAN Option	LP	15:1	0x0000 per specification
LAN Option	LP	0	0x00 for PLC/HPNA cards 0x01 for MII cards
LAN Vendor ID	LP + 0x02	15:0	When LAN is incorporated, Non Zero value matching the PCI Configuration space Subsystem Vendor ID register of the corresponding onboard component
LAN Model ID	LP + 0x04	15:0	When LAN is incorporated, Non Zero value matching the PCI Configuration space Subsystem ID register of the corresponding onboard component
LAN Compliance	LP + 0x06	15:0	Depending upon LAN Option (Offset LP) bit 0: <ul style="list-style-type: none"> <li>For PLC/HPNA 8-bit interface, either 0x0000 or 0x02A0</li> <li>For MII 17 bit interface, either 0x00A4 or 0x0556</li> </ul>

#### 8.1.2.1. Setup

Use a motherboard with known good system BIOS and correctly routed LAN CNR connector for the card under test. Either

- Configuration #2 will test a known PLC/HPNA capable motherboard with a PLC/HPNA riser.
- Configuration #4 will test a known MII capable motherboard with a MII riser.

#### 8.1.2.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

##### 8.1.2.2.1. The test fails if:

The Function ID register bit 4 is set to 0.

- The LAN Pointer register is set to zero, indicating LAN is not supported.
- The upper 15 bits of the LAN Option register are not set to 0.
- The MII/LCI interface bit is not set correctly.
- The LAN CNR Vendor ID register is set to 0.
- The LAN CNR Model ID register is set to 0.
- The LAN compliance register is not an allowable value for the incorporated interface.

#### 8.1.2.2.2. The test *aborts* if:

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

### 8.1.2.3. Test Algorithm

The Riser PnP EEPROM Consistency test (EECONTST) addresses CNR compliance of the PnP EEPROM by verifying the contents of the CNR EEPROM master configuration space register map.

The EECONTST-L test performs the following steps:

12. Check for presence of the CNR hardware by running EECONTST test.
13. Verify that the contents of the CNR Function ID register, located at offset 0x08 of the EEPROM data, contain the value 0x01 at bit 4.
14. Verify that the contents of the LAN Pointer, located at offset 0x16 does not contain 0x00.
15. Determine the LAN **function\interface** implemented on the CNR card.
  - d. PLC/HPNA: If the LAN Option Register is set to 0 at bit 0.
  - e. MII: If the LAN Option Register is set to 1 at bit 0.
16. Verify that the LAN CNR Vendor ID, located at the LAN Pointer offset 0x02 of the EEPROM data, does not contain 0x00.
17. Verify that the LAN CNR Model ID, located at the LAN Pointer offset 0x04 of the EEPROM data, does not contain 0x00.
18. Verify the LAN compliance register is valid for the LAN **function\interface** implemented on the CNR card.
  - a. PLC/HPNA: The LAN Compliance Register is set to 0x0000 or 0x02A0.
  - b. MII: The LAN Compliance Register is set to 0x00A4 or 0x0556

### 8.1.3. Riser SMBus EEPROM Consistency Test Description (Optional)

This part of the test will be executed each time the EECONTST.exe is called. No command line options are required. This test is only run if the SMBus pointer is implemented since the CNR specification 1.1 does not require it.

The test covers the following assertions: 1.5.1 and 1.5.2

The CNR under test should contain an EEPROM that contains the PnP data for the riser. This EEPROM should be the only SMBus device onboard the card. To test this, the EEPROM will be scanned and data parsed per the CNR Specification. Beyond the Generic Riser test assertions, the following values should be as indicated:

Register Name	Offset	Bit	Expected Value
SMBus Pointer	0x14	15:0	There is no expected value. If the value is 0x0000, SMBus compliance section is not implemented in this EEPROM. The SMBus compliance and reserved registers are not tested. If there is a Non Zero value, it shall be pointing to a valid SMBus Compliance register.
SMBus	SP	15:0	Indicates the SMBus compliance of the board. This value

Compliance			should be at least 0x0100.
SMBus Reserved Space	SP+2	31:0	0x00000000 per specification

### 8.1.3.1. Setup

Place the Riser under test into any known good CNR capable motherboard.

### 8.1.3.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

#### 8.1.3.2.1. The test *fails* if:

- CNR EEPROM is not readable.
- Function ID register bit 3 is not set.
- SMBus pointer register is non-zero and SMBus compliance register is set to 0.
- SMBus pointer register is non-zero and SMBus reserved space is non-zero.

#### 8.1.3.2.2. The test *aborts* if:

No CNR card or No CNR connector is present in this system.

- The software stack fails to query CNR EEPROM device.

### 8.1.3.3. Test Algorithm

The Riser PnP EEPROM Consistency test (EECONTST) addresses CNR compliance of the PnP EEPROM by verifying the contents of the CNR EEPROM master configuration space register map.

The EECONTST-S test performs the following steps:

19. Check for presence of the CNR hardware by running EECONTST test.
20. Verify that the contents of the CNR Function ID register, located at offset 0x08 of the EEPROM data, contain the value 0x01 at bit 3.
21. Verify that the SMBus pointer register, located at offset 0x14 of the EEPROM data, does not contain the value 0.
  - a. The contents of the SMBus Compliance register should contain 0x01000.
  - b. The contents of the SMBus reserved register should contain 0x000.

### 8.1.4. USB Riser EEPROM Consistency Test Description

This portion of the test will be executed when the "-U" or "-u" command line options are used on the EECONTST executable.

This test covers assertions: 1.6.1 to 1.6.5

After reading the CNR EEPROM data from the SMBus address range from (0xA0-0xAE), the data will be parsed byte-wise per the CNR Specification. If USB is incorporated onto the CNR card, beyond the tests described in the General Riser PnP EEPROM Test, the following will be tested.

Register Name	Offset	Bit	Expected Value
Function ID	0x08	2	0x01
USB Pointer	0x12	15:0	When USB is incorporated, Non Zero value pointing to valid USB Option register for that card. This value is the UP value. When USB is not incorporated, this register is 0x0000

USB Option	UP	15:4	0x00 per specification
USB Option	UP	3	0x01 for cards containing USB hubs 0x00 for non-Hub CNR cards
USB Option	UP	2	0x01 for cards capable of supporting a wake-up event 0x00 for cards incapable of supporting a USB wake-event
USB Option	UP	1:0	0x00 for cards requiring USB 1.x 0x01 for cards requiring USB 2.0 All other values are illegal
USB Compliance	UP+2	15:0	0x0100 or higher

#### 8.1.4.1. Setup

Using a motherboard with the proper USB version routed to the CNR connector, install the CNR card.

#### 8.1.4.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

##### 8.1.4.2.1. The test *fails* if:

- Function ID register bit 2 is set to 0
- USB Pointer Register is set to 0.
- USB option register reserved bits (15:4) are not set to 0.
- USB compliance register is less than 0x0100.
- CNR EEPROM device does not support USB correctly per if Bits 15 through 4 of the USB option register are not programmed with zero
- USB 2.0 card does not have option register programmed correctly per version
- USB option register bits 1:0 are set to reserved values.

##### 8.1.4.2.2. The test *aborts* if:

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

#### 8.1.4.3. Test Algorithm

The Riser PnP EEPROM Consistency test (EECONTST) addresses CNR compliance of the PnP EEPROM by verifying the contents of the CNR EEPROM master configuration space register map.

At the time of this printing, the algorithm was not available.

### 8.1.5. Riser AC Link EEPROM Consistency Test

This portion of the test will be executed when the "-A" or "-a" command line options are used on the EECONTST executable.

This test covers the following assertions: 1.7.1 to 1.7.11

The CNR under test should contain an EEPROM that contains the PnP data for the riser. To test this, the EEPROM will be scanned and data parsed per the CNR Specification. The following values should be as indicated:

Register Name	Offset	Bit	Expected Value
AC'97	0x06	15:0	0x0210 per specification.



Compliance			
Function ID	0x08	1	0x01 per specification if an Audio Codec is present on the CNR card, this includes AMC codecs
Modem Pointer	0x10	15:0	A Non Zero value pointing to a valid Modem CNR Vendor ID register.
Modem CNR Vendor ID	MP	15:0	If Modem or AMC codec is present on the CNR, this value shall be non-zero, valid CNR Vendor ID (per PCI SIG)
Modem CNR Model ID	MP+0x02	15:0	If Modem or AMC codec is present on the CNR, this value shall be non-zero, valid CNR Model ID (per card vendor)
Function ID	0x08	0	0x01 per specification if a Modem Codec is present on the CNR card, this includes AMC codecs.
Audio Pointer	0x0E	15:0	A non-zero value pointing to a valid Audio CNR Vendor ID register.
Audio CNR Vendor ID	AP	15:0	If Audio or AMC codec is present on the CNR, this value shall be non-zero, valid CNR Vendor ID (per PCI SIG)
Audio CNR Model ID	AP+0x02	15:0	If Audio or AMC codec is present on the CNR, this value shall be non-zero, valid CNR Model ID (per card vendor)
Multi Channel Signature	AP+0x04	15:0	If Audio or AMC codec is present on the CNR, this value shall be non-zero only if the CNR card is designated as an upgrade to the existing motherboard audio solution. Unless a valid motherboard is used for testing that recognizes the signature used, this register is for information only. This value is optional.
Multi Channel Model ID	AP+0x06	15:0	If Audio or AMC codec is present on the CNR, this value shall be non-zero only if the CNR card is designated as an upgrade to the existing audio solution. Unless a valid motherboard is used for testing that recognizes the signature used, this register is for information only. This value is optional.

### 8.1.5.1. Setup

Install the CNR card on a known good motherboard with AC Link routed but with no AC'97 codecs onboard.

Index	Riser	Motherboard	Status	Test Focus
10	Single AC Link Codec	AC Link routed	Valid	BIOS/EEPROM/HW
11	Two Codecs	AC Link routed	Valid	BIOS/EEPROM/HW

### 8.1.5.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

#### 8.1.5.2.1. The test fails if:

On Audio capable (Audio Codec or AMC) CNR cards,

- Function ID register bit 0 is set to 0.
- Audio Pointer Register is set to 0.
- Audio CNR Vendor ID Register is set to 0.
- Audio CNR Model ID Register is set to 0.

- Optionally, on Audio Upgrade capable where an Audio Codec or AMC is designed to be used to allow enhanced audio functionality on the platform CNR cards,
- Multi-channel signature register is set to 0. (Optional)
- Multi-channel Model ID register is set to 0. (Optional)

On Modem capable (Modem Codec or AMC) CNR cards,

- Function ID register bit 1 is set to 0.
- Modem Pointer Register is set to 0.
- Modem CNR Vendor ID Register is set to 0.
- Modem CNR Model ID Register is set to 0.

**8.1.5.2.2. The test *aborts* if:**

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

**8.1.5.3. Test Algorithm**

The Riser PnP EEPROM Consistency test (EECONTST) addresses CNR compliance of the PnP EEPROM by verifying the contents of the CNR EEPROM master configuration space register map.

At the time of this printing, the algorithm was not available.

**8.1.6. Riser AC Link Demotion and Multi Channel Audio Test**

This is a 2 step test. You run the EEPROM consistency test 2x...then you have to do a comparison.

Assertions 1.7.12 and 1.7.13

Proper Codec Demotion requires proper control of the CDC\_DN\_ENAB# signal by both motherboard and CNR. CDC\_DN\_ENAB# is normally a GPIO on the motherboard from the core logic chipset to the CNR connector which allows the system BIOS to read this signal to determine if there is a possibility of CNR or the motherboard is controlling the AC Link.

Motherboard manufacturers implement circuitry between AC\_RESET# and CDC\_DN\_ENAB# to allow CNR codecs to interface correctly to the AC link (see section 3.3 of the CNR specification). Motherboards with Codecs down will have a 10K ohm pull down resistor on the CDE signal. Motherboards without codecs down will have a weak-up resistor indicating that the CNR is always in control.

CNR cards shall have the right value resistor onboard to complete the motherboard circuit depending upon the AC Link features on the CNR. CNR cards with multiple codecs are expected to put a strong pull-up on the CDE line that will hold all onboard codecs in reset, disabling the onboard codecs. CNR cards with single codecs are expected to have weak pull-up resistors on the CDE line that will allow onboard codecs to function.

Optionally, Audio and AMC CNR cards can paths for motherboard vendors to upgrade their existing audio solution. This upgrade path is predetermined by both the CNR vendor and the motherboard vendor as the motherboard and CNR must share common audio codecs and the system BIOS must contain the multi-channel signature of the CNR card. The CNR PnP EEPROM must contain the correct multi-channel signature and the multi-channel model ID register values.

**8.1.6.1. Setup**

CNR card testing setup is dependent on CNR card configuration.

Index	Riser	Motherboard	Status
12	Modem Codec	Audio down	Valid
13	AMC Codec	Audio down	Valid Upgrade for Multi-Channel
24	Audio Codec	None	Valid

14	Audio Codec	AMC down	Valid Upgrade for Multi-Channel
18	Audio & Modem Codecs	Audio & Modem Codecs	Replacement only

For CNR Cards with a Modem codec only (**not** AMC):

Configuration #12: Populate CNR on a motherboard with Audio down. This will test if the resistor on the CNR is correct (weak pull-up). A weak pull-up will allow the BIOS to program the onboard audio SSID from the motherboard and the modem codec SSID from the CNR card. Audio will be the primary codec, Modem will be the secondary codec in this scenario.

For CNR Cards with an Audio codec only (**not** AMC):

Configuration #24: Populate an Audio CNR on a board with AC' Link routed but no codecs down. This will test if the Audio CNR card does not have a strong pull down resistor on the CDC\_DN\_ENABL# pin.

Configuration #14: Optionally, for multi-channel audio testing, install the Audio CNR card on a known good, IHV provided, motherboard with a single audio codec solution (AMC or audio) down which is designed to work with the CNR card under test. If the Audio CNR is designed to be an upgrade, then the IHV shall provide the motherboard since the onboard audio or AMC solution and system BIOS will be specific for that CNR card upgrade. If the Audio CNR that is designed for upgrade is installed on any other board, the BIOS will disabled the audio functionality.

For CNR cards with both Audio and Modem Codecs:

Configuration #18: Populate CNR on a board with both Audio and Modem codecs down. This will test if the resistor on the CNR is correct (strong pull-up), bring the CDE line high...the BIOS should program the Audio and Modem SSID from the CNR card as both onboard codecs will be held in reset. Since 3 codecs cannot share the AC Link, any onboard codecs should be disabled.

For CNR cards with AMC solutions:

Configuration #13: AMC solutions can be tested with Audio down solutions only. Modem Codecs or AMC down motherboards would result in the modem functionality being disabled by the system BIOS. If the AMC CNR is designed to be a replacement, then the Audio codec should be disabled by a strong pull-up. If the AMC is designed to be an upgrade, then the IHV shall provide the motherboard since the onboard audio codec and system BIOS will be specific for that CNR card upgrade. If the AMC CNR that is designed for upgrade is installed on any other board, the BIOS will disable the audio functionality.

### 8.1.6.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and states "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

Test Failures are dependent upon CNR and Motherboard combinations. The failures listed below assume the EEPROM consistency test was performed.

#### 8.1.6.2.1. The test *fails* if:

On Modem only CNR cards,

- The onboard Audio Codec is disabled or missing from PCI configuration space.
- The Modem Codec is disabled or missing from PCI configuration space.

On Audio only CNR cards,

- The onboard Modem Codec was disabled or missing from PCI configuration space.
- The Audio Codec is disabled or missing from PCI configuration space
- Number of audio channels available were less than expected. (Optional)

On Audio & Modem CNR cards,

- The onboard Audio or Modem Codecs were still enabled as seen in PCI configuration space.

On AMC CNR cards,

- The Audio Codecs are disabled as seen in PCI configuration space.

**8.1.6.2.2. The test *aborts* if:**

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

**8.1.6.3. Test Algorithm**

The Riser PnP EEPROM Consistency test (EECONTST) addresses CNR compliance of the PnP EEPROM by verifying the contents of the CNR EEPROM master configuration space register map.

At the time of this printing, the algorithm was not available.

## **8.2. Motherboard BIOS EEPROM Validation Support Test**

This test confirms via the user that the proper POST error message was displayed and confirms the mismatched function was disabled when needed. The following assertions will be exercised as part of this test:

1.1.1 through 1.1.13, 1.1.16

Using a valid CNR card, the test modifies the PnP EEPROM contents one register at a time and reboots to check for BIOS behavior. This test focuses on the PnP EEPROM contents common to most CNR cards including:

- Checksum is invalidated
- CNR card version is set to an undefined high value
- AC'97 version is set to an undefined high value
- USB compliance version is set to an undefined high value
- USB SPD bits are set to a reserved value
- Function ID bits and pointers are set incorrectly
- LAN compatibility bit is flipped
- SMBus version is set to an undefined high value

For negative assertions to be tested, the PnP EEPROM shall be readable and writeable by the host; however, some motherboards will either hide or disable the SMBus. This is an automated test that shall read and write all data from a known valid CNR PnP EEPROM. To confirm the EEPROM being overwritten is the PnP EEPROM, the EEPROM ID is detected. After detection, the PnP EEPROM will be overwritten by a test pattern, then read back to confirm that the contents are altered. After the test, the original PnP EEPROM contents will then be restored to the CNR card and write will be confirmed.

After the alteration is made to the EEPROM, the system is rebooted (cold boot so the system fully resets). The system BIOS reads the erroneous PnP EEPROM information, given a chance to display an error message during POST, then finishes booting. The test then picks up from where it left off: reads the PnP EEPROM; posts the error message it expects to have been displayed on the screen, then asks the test operator if the message was seen during POST (the response will time out after 10 seconds assuming it was a "pass"). Next, the test checks the disable/enable status of the functions per the error. The test then restores the correct information to the CNR card, and cycles to the next byte error and repeats or exits when done.

### 8.2.1.1. Setup

Install a valid Audio/Modem CNR on a properly routed motherboard.

### 8.2.1.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

#### 8.2.1.2.1.1. The test *fails* if:

- The CNR card or function is enabled when it should be disabled for any one of the alterations.
- If the user click's "NO" to the question of the display message.

#### 8.2.1.2.1.2. The test *aborts* if:

- No CNR card or NO CNR connector is present in this system.
- EEPROM ID is not found in the correct offset of any SMBus address.
- PnP EEPROM is not writeable i.e. The Test Pattern is not detected after performing a write on system or the EEPROM contents are not restored correctly.

### 8.2.1.3. Test Algorithm

The Motherboard BIOS EEPROM Validation test (MBVALTST.exe) addresses motherboard BIOS error detection and recovery of the CNR PnP EEPROM.

1. Check for Readability of EEPROM.
2. Check for Write-ability of EEPROM.
3. Determine capabilities of the current CNR card and motherboard.
4. Save PCI system state for comparison.
5. Write out a specific error condition in the EEPROM.
6. Save flag file to determine where current state of test.
7. Reboot the system.
8. Allow Boot to proceed to boot to WHQL CNR test again.
9. Check flag to see which state the test should be in.
10. Ask user if there was an error in the boot up cycle. (ie F1...etc.) Optionally timeout after 30 seconds to see if there was an error.
11. Check PCI space for expect disabled functions when appropriate.
12. Log failure or passing.
13. Restore original configuration of EEPROM.
14. Repeat steps 4 to 13 until all error conditions are tested.

## 8.3. Motherboard AC Link Test

It is the motherboard system BIOS responsibility to enable and configure the AC Link functions during POST. The motherboard uses onboard circuits and GPIOs to detect the CDC\_DN\_ENBL# and AC\_RESET# signals which are OEM dependent in the detection of codecs. Since it would be difficult to

encompass the GPIO inputs used by the system BIOS in the test to judge the state of CDC\_DN\_ENBL#, various combinations of CNR cards will be installed on the motherboard to determine compliance. The PnP EEPROM contents and AC'97 PCI configuration spaces will be examined after each boot cycle.

In AC Link PCI configuration registers for SVID and SSID are compared to the values in the PnP EEPROM. Improper programming of these values will result in drivers failing to load. The CNR cards used for this test are known-good, therefore the motherboard is considered the suspect component.

First, the test runs on a motherboard with no CNR cards onboard to level-set the test for onboard components. The PCI space will be examined for audio and modem controller information. Any onboard devices will have motherboard SVID and SSID registers programmed. Next, valid combinations will be populated with known good CNR cards ensuring the SVID and SSID registers are updated per PnP EEPROM. Invalid motherboard/CNR combinations will be tested in the demotion test in following sections. For motherboard testing, multi-function codecs or dual codecs down will be tested without any CNR cards installed; further testing is performed under the demotion and Multi-channel upgrade test.

**Note: The test operator should examine the BIOS setup menu and/or motherboard jumpers/switches to ensure the onboard Codecs are enabled if present.**

### 8.3.1. Setup

Setup is dictated by configuration.

Index	Motherboard	Riser	Status	Test Focus
23	AC Link routed	None	Valid	BIOS/EEPROM/HW
10	AC Link routed	Single AC Link Codec	Valid	BIOS/EEPROM/HW
11	AC Link routed	Two Codecs	Valid	BIOS/EEPROM/HW
24	Audio down	None	Valid	BIOS/EEPROM/HW
12	Audio down	Modem Codec	Valid	BIOS/EEPROM/HW
25	Modem down	None	Valid	BIOS/EEPROM/HW
26	AMC down	None	Valid	BIOS/EEPROM/HW
27	Audio & Modem	None	Valid	BIOS/EEPROM/HW

#### A motherboard with no AC Link codecs down

Configuration #23: Without any CNR cards installed, run the test. This will test if the audio and modem controllers are disabled on the motherboard and there is no default SVID/SSID programmed into the configuration space.

Configuration #10: Install an Audio CNR on the motherboard under test. This will test if the SVID/SSID is programmed correctly per the PnP EEPROM by the BIOS and that the AC\_RESET# and CDC\_DN\_ENABLE signal are implemented correctly.

Configuration #11: Install an Audio & Modem CNR on the motherboard under test. This will test if the SVID/SSID is programmed correctly for both Audio and Modem per the PnP EEPROM.

#### Audio Codec Onboard:

Configuration #24: The test is performed without any CNR cards installed on a motherboard with audio down. This will test if the modem controller is disabled on the motherboard and there is no default SVID/SSID programmed into the configuration space. It will also test the Audio controller PCI Space for onboard codec SVID and SSID information.

Configuration #12: Install a Modem Codec CNR on the motherboard under test. The PnP EEPROM information should be copied into the correct locations in PCI Space for the modem function.

#### AMC Codec Onboard:

Configuration #26: The test is performed without any CNR cards installed on a motherboard with AMC down. This will test if the Audio and modem controllers are enable and read the onboard codecs' SVID and SSID information.

Audio & Modem Codecs Onboard:

Configuration #27: The test is performed without any CNR cards installed on a motherboard with Audio and Modem codecs down. This will test if the Audio and modem controllers are enable and read the onboard codecs' SVID and SSID information.

Modem Down motherboards:

Configuration #25: The test is performed without any CNR cards installed on a motherboard with modem down. This will test if the audio controller is disabled on the motherboard and there is no default SVID/SSID programmed into the configuration space. It will also test the Modem controller PCI Space for onboard codec SVID and SSID information.

### 8.3.2. Interpretation of Results

Test Failures are dependent upon CNR and Motherboard combinations. The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

#### 8.3.2.1. The test *fails* if:

On motherboard with no codecs down,

- The Audio or Modem controllers were enabled or the PCI configuration space SVID and SSID registers were programmed.
- The CNR Audio Codec is disabled or missing from PCI configuration space in configuration #10.
- The Modem function is enabled in configuration #10.
- The Audio or Modem Codecs are disabled or missing from PCI configuration space in configuration #11.
- If the PCI space SVID or SSID were not set per PnP EEPROM contents for configuration #10 or #11.

On motherboard with Audio only,

- The Audio Codec is disabled in configuration #24.
- The Audio Codec SVID or SSID is not programmed on configuration #24.
- The modem codec was enabled in PCI configuration space in configuration #24.
- The modem codec controller SVID or SSID was programmed to a default value in configuration #24.
- The CNR Modem Codec was disabled or missing from PCI configuration space in configuration #12.
- The Audio Codec is disabled or missing from PCI configuration space in configuration #12.
- The modem specific PnP EEPROM contents are not correctly transferred to the SVID/SSID in the proper PCI configuration space location in configuration #12.
- The Audio Codec SVID and SSID registers are altered in configuration #12 from configuration #24.

On motherboard with Modem only,

- The Modem Codec is disabled in configuration #25.
- The Modem Codec SVID or SSID is not programmed on configuration #25.
- The Audio codec was enabled in PCI configuration space in configuration #25.
- The Audio codec controller SVID or SSID was programmed to a default value in configuration #25.

On motherboard with AMC down or Audio & Modem codecs,

- The Audio Coded or Modem Codec is disabled or missing from PCI configuration space.
- The Audio Codec or Modem Codec SVID or SSID is not programmed.

### 8.3.2.2. The test *aborts* if:

- This test will not abort.

### 8.3.3. Test Algorithm

The Motherboard AC Link test (MBACLINK) addresses motherboard BIOS ability to detect, program and enable the codecs both onboard and on the CNR card for allowable configurations.

At the time of this printing, the algorithm was not available.

## 8.4. Motherboard AC Link Demotion

It is the motherboard hardware and system BIOS responsibility to enable and configure the AC Link functions during POST. As in the AC Link Test, the HCT cannot predict which GPIO is used for CDC\_DN\_ENBL# or AC\_RESET# detection; hence several CNR/motherboard combinations will be used to determine motherboard compliance. Both valid and invalid combinations will be used.

Some invalid combinations will be used to check the system BIOS functionality, such as:

- If multiple Modem Codecs are present and not held in reset, the BIOS will disable the modem functionality.
- If 3 codecs or more are present on the system and not disabled via hardware, the BIOS will disable the AC Link functionality on the motherboard via PCI space.
- If multi-channel audio upgrade mismatch occurs the BIOS will disable the audio functionality.

For motherboards with onboard Audio (Audio Codec or AMC down), an upgrade is possible via CNR. To do this, the system BIOS must contain the CNR-specific multi-channel signature. If the Motherboard is designed to be with an Audio or AMC CNR as a potential upgrade, the OEM shall provide the corresponding CNR card since the onboard audio or AMC solution and system BIOS will be specific for that CNR card upgrade. If any other Audio CNR solution is populated, the BIOS will disable the audio functionality after determining if either the audio codec vendors or multi-channel signature (should one exist) mismatch.

### 8.4.1. Setup

Setup depends upon the motherboard configuration:

Index	Motherboard	Riser	Status	Test Focus
12	Audio down	Modem Codec	Valid	BIOS/EEPROM/HW
16	Audio down	Audio & modem	Invalid	BIOS
19	AMC down	Modem	Invalid	BIOS



20	AMC down	AMC	Invalid	BIOS
15	Modem down	Audio	Invalid	BIOS/EEPROM/HW
21	Modem down	Modem	Invalid	BIOS
22	Modem down	AMC	Invalid	BIOS
17	Audio & modem	Single Codec	Invalid	BIOS

Audio Codec Onboard:

Configuration #12: Install a Modem Codec CNR on the motherboard under test. The PnP EEPROM information should be copied into the correct locations in PCI Space for the modem function.

Configuration #16: Install an Audio & Modem Codec CNR on the motherboard under test. Since 3 codecs cannot exist, this is an invalid combination and both audio and modem PCI devices should be disabled by the BIOS.

AMC Codec Onboard:

Configuration #19 will test a motherboard with AMC down with a Modem riser. Since more than one modem cannot be supported on the AC link, this is an invalid combination. The BIOS should disable Modem functionality on the board and flag the user.

Configuration #20 will test a motherboard with AMC down with an AMC riser. Since more than one modem cannot be supported by AC link, this is an invalid combination. The BIOS should disable both audio and modem functionality on the board and flag the user.

Modem Down motherboards:

Configuration #15 will combine the modem down motherboard with an audio riser. The BIOS should disable the Audio functionality as the onboard modem codec will always be primary.

Configuration #21 will combine the modem down motherboard with a modem riser. Since more than one modem cannot be supported on the AC link, this is an invalid combination. The BIOS should disable the Modem functionality on the board and flag the user.

Configuration #22 will combine the modem down motherboard with an AMC riser. Since more than one modem cannot be supported on the AC link, this is an invalid combination. The BIOS should disable the Modem functionality on the board and flag the user.

Motherboards with Audio & Modem Codecs Down:

Configuration #17 will test a motherboard with audio and modem down with a riser with any single codec (audio or modem) or with an audio/modem combination riser. Since 3 codecs cannot exist, this is an invalid combination and both audio and modem PCI devices should be disabled by the system BIOS.

**8.4.2. Interpretation of Results**

Test Failures are dependent upon CNR and Motherboard combinations. The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

**8.4.2.1. The test *fails* if:**On motherboard with Audio only.

- The CNR Modem Codec was disabled or missing from PCI configuration space in configuration #12.
- The Audio Codec is disabled or missing from PCI configuration space in configuration #12.

- The PnP EEPROM contents are not correctly transferred to the SVID/SSID in the proper PCI configuration space location in configuration #12.
- Any AC Link functionality is still enabled via PCI Space in configuration #16.

On motherboard with AMC CNR codecs.

- The Audio Codec is disabled as seen in PCI configuration space in configuration #19.
- The Modem functionality is still enabled as seen in PCI configuration space in configuration #19.
- The Modem functionality is still enabled as seen in PCI configuration space in configuration #20.
- The Audio functionality is still enabled as seen in PCI space in configuration #20.

On motherboard with Modem only.

- The CNR Audio Codec remained enabled in PCI configuration space in configuration #15.
- The Modem Codec is disabled or missing from PCI configuration space in configuration #15.
- The modem controller PCI configuration registers, SVID/SSID are altered from their original values.
- Any AC Link controller is enabled in PCI configuration space in configuration #21.
- The Modem Codec is enabled in PCI configuration space in configuration #22.

On motherboard with Audio & Modem codecs.

- Any of the AC Link functionality is still enabled via PCI space in configuration #17.

**8.4.2.2. The test *aborts* if:**

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

**8.4.3. Test Algorithm**

The Motherboard AC Link test (MBACLINK) addresses motherboard BIOS ability to detect, program and enable the codecs both onboard and on the CNR card for allowable configurations.

AC Link Demotion and Multi-Channel Test Setup and Algorithm

```
#define StrAC_DEMOTION1 "C:\\ACDEMOT1.LOG"  
#define StrAC_DEMOTION2 "C:\\ACDEMOT2.LOG"
```

Setup

1. Boot up with MB and AC Riser
2. Delete all temp files from C:\\, "ACDEMOT1.LOG" and "ACDEMOT2.LOG"
3. Run first-run of demotion test
4. Shut down and remove AC Riser from MB and reboot
5. Run second-run of demotion test
6. After second run, run test again
7. Verify log

Algorithm

1. Check if StrAC\_DEMOTION1 exists. This will be the first run of demotion test with MB and Riser. If not exists, then copy current CNRTEST.LOG data into StrAC\_DEMOTION1 file and write.
2. Re-run the demotion test without riser on board.

3. Check if StrAC\_DEMOTION2 exists. This will be the second run of demotion test with MB only. If not exists, then copy current CNRTEST.LOG data into StrAC\_DEMOTION2 file and write.
4. Re-run the demotion test—does not matter if riser is onboard or not.
5. If StrAC\_DEMOTION1 and StrAC\_DEMOTION2 exists, and it should, then read through those two files and retrieve values for modem, audio, and modem/audio and store them into two DemotionStores structs.
6. Verify values between the two structs. Inference1: If two values match, this means either the riser did not contain codec, or if the riser contains codec and has the same value as the MB, this portion of the test should fail. Inference2: If values do not match and there is codec on the riser, this portion of the test should pass.

## 8.5. Motherboard Multi Channel Signature Test

It is the motherboard system BIOS responsibility to enable and configure the AC Link functions during POST.

For motherboards with onboard Audio (Audio Codec or AMC down), an upgrade is possible via CNR. To do this, the system BIOS must contain the CNR-specific multi-channel signature. If the Motherboard is designed to be with an Audio or AMC CNR as a potential upgrade, the OEM shall provide the corresponding CNR card since the onboard audio or AMC solution and system BIOS will be specific for that CNR card upgrade. If any other Audio CNR solution is populated, the BIOS will disable the audio functionality after determining if either the audio codec vendors or multi-channel signature (should one exist) mismatch.

In AC Link PCI configuration registers for SVID and SSID are compared to the values in the PnP EEPROM. Improper programming of these values will result in drivers failing to load. Different CNR and motherboard configurations are required for full testing.

Some invalid combinations will be used to check the system BIOS functionality, such as:

- If multi-channel audio upgrade mismatch occurs the BIOS will disable the audio functionality.
- If 3 codecs or more are present on the system and not disabled via hardware, the BIOS will disable the AC Link functionality on the motherboard via PCI space.

### 8.5.1. Setup

Setup depends upon the motherboard configuration:

Index	Motherboard	Riser	Status	Test Focus
13	Audio down	AMC	Valid Upgrade	BIOS/EEPROM/HW
29	Audio down	AMC	Invalid Upgrade	BIOS/EEPROM/HW
28	Audio down	Audio Codec	Valid Upgrade	BIOS/EEPROM/HW
30	Audio down	Audio Codec	Invalid Upgrade	BIOS/EEPROM/HW
14	AMC down	Audio Codec	Valid Upgrade	BIOS/EEPROM/HW
31	AMC down	Audio Codec	Invalid Upgrade	BIOS/EEPROM/HW
20	AMC down	AMC	Invalid	BIOS
17	Audio & modem	Audio Codec	Invalid	BIOS

#### Audio Codec Down:

Configuration #13: Install the OEM-provided AMC riser card designed to be an upgrade on the motherboard under test with an Audio codec down. This test is optional.

Configuration #28: Install the OEM-provided Audio CNR card designed to be an upgrade on the motherboard under test with an Audio codec down. This test is optional.

Configuration #29: Install the non-multi-channel AMC CNR card not designed to be an upgrade on the motherboard under test with an Audio codec down. The BIOS should disable the audio controller on the motherboard.

Configuration #30: Install the non-multi-channel Audio CNR card not designed to be an upgrade on the motherboard under test with an Audio codec down. The BIOS should disable the audio controller on the motherboard.

#### AMC Codec Onboard:

Configuration #14: Install the OEM-provided Audio CNR card designed to be an upgrade on the motherboard under test with an AMC codec down. This test is optional.

Configuration #31: Install the non-multi-channel Audio CNR card not designed to be an upgrade on the motherboard under test with an AMC codec down.

Configuration #20 will test a motherboard with AMC down with an AMC riser. Since more than one modem cannot be supported by AC link, this is an invalid combination. The BIOS should disable both audio and modem functionality on the board and flag the user.

#### Motherboards with Audio & Modem Codecs Down:

Configuration #17 will test a motherboard with audio and modem down with a riser with audio riser. Since 3 codecs cannot exist, this is an invalid combination and both audio and modem PCI devices should be disabled by the system BIOS. Mutli-channel support is impossible in this case.

## **8.5.2. Interpretation of Results**

Test Failures are dependent upon CNR and Motherboard combinations. The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

### **8.5.2.1. The test *fails* if:**

#### On motherboard with audio codecs down,

- The CNR Audio controller is disabled or missing from PCI configuration space in configuration #13.
- If the Audio controller's PCI configuration space SVID or SSID were not set per PnP EEPROM contents in configuration #13.
- The CNR modem controller is disabled or missing from PCI configuration space in configuration #13.
- If the modem controller's PCI configuration space SVID or SSID were not set per PnP EEPROM contents in configuration #13.
- The CNR Audio controller is disabled or missing from PCI configuration space in configuration #28.
- If the Audio controller's PCI configuration space SVID or SSID were not set per PnP EEPROM contents in configuration #28.
- The CNR modem controller is enabled in PCI configuration space in configuration #28.
- The CNR Audio controller is enabled from PCI configuration space in configuration #29.
- The CNR modem controller is disabled or missing in PCI configuration space in configuration #29.

- Any AC Link controller is enabled from PCI configuration space in configuration #30.

On motherboard with AMC CNR codecs,

- The CNR Audio controller is disabled or missing from PCI configuration space in configuration #14.
- If the Audio controller's PCI configuration space SVID or SSID were not set per PnP EEPROM contents in configuration #14.
- The CNR modem controller is disabled or missing from PCI configuration space in configuration #14.
- If the modem controller's PCI configuration space SVID or SSID were not set per PnP EEPROM contents in configuration #14.
- The CNR Audio controller is enabled in PCI configuration space in configuration #31.
- The CNR modem controller is disabled or missing from PCI configuration space in configuration #31.
- If the modem controller's PCI configuration space SVID or SSID were not set per PnP EEPROM contents in configuration #31.
- Any AC Link controller is still enabled as seen in PCI space in configuration #20.

On motherboard with Audio & Modem codecs,

- Any of the AC Link functionality is still enabled via PCI space in configuration #17.

On motherboard with Audio upgrade capabilities,

- The Audio Codecs are enabled when there is a mismatch in either the vendor ID or the multi-channel ID in configuration #13A or #14A.
- The remains the same number of audio channels as without the upgrade in configuration #13 or #14.

#### **8.5.2.2. The test *aborts* if:**

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

### **8.5.3. Test Algorithm**

The Motherboard AC Link test (MBACLINK) addresses motherboard BIOS ability to detect, program and enable the codecs both onboard and on the CNR card for allowable configurations.

At the time of this printing, the algorithm was not available.

## **8.6. Motherboard BIOS LAN Capability Test**

After reading the CNR EEPROM data from the SMBus address range from (0xA0-0xAE), the data will be parsed byte-wise per the CNR Specification. If the CNR and motherboard are incompatible for any LAN or USB interface, the BIOS shall flag the user during POST with the appropriate error message and disable the interface on the motherboard if necessary.

This test validates that a conflicted interface is disabled via PCI space. To disabled PCI space, PCI Devices can be hidden in some cases, or more commonly have memory and IO disabled via the device's PCI Command register.

### 8.6.1. Setup

Setup depends upon motherboard configuration:

Index	Motherboard	Riser	Status	Test Focus
1	PLC down	PLC	Invalid	BIOS
2	PLC routed	PLC	Valid	BIOS/EEPROM
5	PLC routed	MII PHY	Invalid	BIOS
6	PLC Not Routed	PLC	Invalid	BIOS
3	MII routed	PLC	Invalid	BIOS
4	MII routed	MII PHY	Valid	BIOS/EEPROM

#### For PLC down motherboards:

Configuration #1 will test a PLC down motherboard with a PLC riser. It is expected that when the PLC is down on the motherboard, the designers will not route the LCI to the CNR connector since there cannot exist two PLC devices on the same channel. The BIOS should halt and flag the user since the PLC on the riser will not be functional.

#### For PLC Routed Motherboards:

Configuration #2 will test a PLC routed motherboard with a PLC riser. The micro-wire interface will program the SSID and SVID automatically and enable the PCI space for the integrated LAN. The BIOS checks the information on the PnP EEPROM.

Configuration #5 will also test a PLC routed motherboard but with an MII riser. The incompatibility shall be detected by the BIOS and the user flagged via POST. The BIOS cannot enable the PCI space for the integrated LAN and the micro-wire EEPROM is not connected; therefore, the LAN will remain disabled.

#### For MII routed motherboards:

Configuration #3 with a motherboard with MII routed to the CNR connector, but a PLC riser has been installed.

Configuration #4 with a motherboard with MII routed to the CNR connector, with an MII CNR has been installed. The BIOS should program the SVID/SSID per the PnP EEPROM contents.

#### For motherboards with no LAN routed:

Configuration #6 with a motherboard with no LAN routed to the CNR connector, but a PLC riser has been installed. The BIOS should flag the test operator as the CNR is dead.

### 8.6.2. Interpretation of Results

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

#### 8.6.2.1. The test *fails* if:

##### On motherboard with PLC down,

- The BIOS does not flag the test operator during POST in configuration #1.

##### On motherboard with PLC routed,

- The LAN is disabled in configuration #2.
- The LAN is enabled in configuration #5.
- The BIOS does not flag the test operator during POST in configuration #5.

##### On motherboard with MII routed,

- The LAN is enabled in configuration #3.
- The BIOS does not flag the test operator during POST in configuration #3.
- The LAN is disabled in configuration #4.
- The PCI configuration space is not per PnP EEPROM contents in configuration #4.

On motherboard without LAN routed,

- The LAN is enabled in configuration #6.
- The BIOS does not flag the test operator during POST in configuration #6.

#### **8.6.2.2. The test *aborts* if:**

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

### **8.6.3. Test Algorithm**

The Motherboard LAN test (MBLANTST) addresses motherboard BIOS ability to detect, program and enable the LAN CNR cards for allowable and disable LAN for invalid configurations.

At the time of this printing, the algorithm was not available.

## **8.7. Motherboard BIOS USB Capability Test**

After reading the CNR EEPROM data from the SMBus address range from (0xA0-0xAE), the data will be parsed byte-wise per the CNR Specification. If the CNR and motherboard are incompatible for any LAN or USB interface, the BIOS shall flag the user during POST with the appropriate error message and disable the interface on the motherboard if necessary.

This test validates that a conflicted interface is disabled via PCI space. To disabled PCI space, PCI Devices can be hidden in some cases, or more commonly have memory and IO disabled via the device's PCI Command register.

### **8.7.1. Setup**

Setup depends upon motherboard configuration:

Index	Motherboard	Riser	Status	Test Focus
7	USB 1.x routed	USB	Valid	BIOS/EEPROM
8	USB Not Routed	USB	Invalid	BIOS

For motherboards with USB 1.x routed:

Configuration #7 will test a motherboard USB 1.x routed to the CNR connector with a USB Riser.

For motherboards without any USB routed:

Configuration #8 will test a motherboard without USB routed to the CNR connector with a USB Riser.

### **8.7.2. Interpretation of Results**

The test provides advisory information as applicable on the CNR card and state "Pass" in green if the criteria above are met. If the test fails, it will state "Fail" in red and list which assertions did not pass. If the test aborts, it will state "Abort" in yellow.

On motherboard with USB 1.x routed,

- The USB functions are disabled in configuration #7.

On motherboard without any USB routed.

- The BIOS does not flag the test operator during POST in configuration #8.

**8.7.2.1. The test *aborts* if:**

- No CNR card or No CNR connector is present in this system.
- The software stack fails to query CNR EEPROM device.

**8.7.3. Test Algorithm**

The Motherboard USB test (MBUSBTST) addresses motherboard BIOS ability to detect, and enable the USB correctly depending if the card.

At the time of this printing, the algorithm was not available.



## 9. Glossary

Assertion	<p>An assertion is a truth statement of feature criteria that extracts the precise requirement(s) from a source document's text. Assertions are derived from all pertinent documents such as design guides, industry specifications, and industry standards documents. Assertions include criteria that are both testable and non-testable. The set of assertions forms an interpretation of the source document.</p>
N/A	Not Applicable
Down	<p>An adjective used to describe a component or device that is integrated with the motherboard instead of being "up" on an add-in card. Down devices are soldered or socketed to the motherboard and include associated glue logic. Ex. Some OEMs chose to provide a proven video solution down on the motherboard over the newer integrated chipset.</p>
Up	<p>An adjective used to describe a component or device that is mounted to an add-in card and is populated on the system via a slot. Ex. Having integrated video adapters on the chipset reduces motherboard costs over an up solution.</p>
Routed	<p>An adjective used to describe a set of traces on the motherboard used for a particular function. Ex. Capabilities are routed to the CNR connector shall be known to the system BIOS.</p>

## 10. Appendix A - Test Configuration Matrix

The table below details all combinations of risers and motherboards that will be used in WHQL testing.

Index	Motherboard	Riser	Status	Test Focus
1	PLC down	PLC	Invalid	BIOS
2	PLC routed	PLC	Valid	BIOS/EEPROM
3	MII routed	PLC	Invalid	BIOS
4	MII routed	MII PHY	Valid	BIOS/EEPROM
5	PLC routed	MII PHY	Invalid	BIOS
6	PLC Not Routed	PLC	Invalid	BIOS
7	USB 1.x routed	USB	Valid	BIOS/EEPROM
8	USB Not Routed	USB	Invalid	BIOS
9	<del>USB Not Routed</del>	<del>Non-USB</del>	<del>Valid</del>	<del>Nothing, Deleted</del>
10	AC Link routed	Single Codec	Valid	BIOS/EEPROM/HW
11	AC Link routed	Two Codecs	Valid	BIOS/EEPROM/HW
12	Audio only down	Modem only	Valid	BIOS/EEPROM/HW
13	Audio onlydown	AMC	Valid Upgrade	BIOS/EEPROM/HW
14	AMC down	Audio only	Valid Upgrade	BIOS/EEPROM/HW
15	Modem only down	Audio only	Invalid	BIOS/EEPROM/HW
16	Audio only down	Audio & modem	Invalid	BIOS
17	Audio & modem	Single CODEC	Invalid	BIOS
18	Audio & modem	Audio & modem	Replacement, disables all down codecs	BIOS/EEPROM/HW
19	AMC down	Modem only	Invalid	BIOS
20	AMC down	AMC	Invalid	BIOS
21	Modem only down	Modem only	Invalid	BIOS
22	Modem only down	AMC	Invalid	BIOS
23	AC Link routed	None	Valid	BIOS/EEPROM/HW
24	Audio only down	None	Valid	BIOS/EEPROM/HW
25	Modem only down	None	Valid	BIOS/EEPROM/HW
26	AMC down	None	Valid	BIOS/EEPROM/HW
27	Audio & Modem	None	Valid	BIOS/EEPROM/HW
28	Audio only down	Audio only	Valid Upgrade	BIOS/EEPROM/HW
29	Audio only down	AMC	Invalid Upgrade	BIOS/EEPROM/HW
30	Audio only down	Audio only	Invalid Upgrade	BIOS/EEPROM/HW
31	AMC down	Audio only	Invalid Upgrade	BIOS/EEPROM/HW

## 11. Appendix B - Test Coverage Matrices

Key:

Symbol	Covered/Not Covered
<b>Valid</b>	Valid combination covered by the test
<b>Invalid</b>	Invalid combination covered by the test. Expect an error from this combination.
Valid	Valid combination but not covered by the test
Invalid	Invalid combination not covered by the test
N/A	Not Applicable, not tested

### 11.1. LAN Test Coverage Matrix

LAN Combination Coverage Matrix

Motherboards	-----Risers-----					
	PLC	Non PLC	HPNA	Non HPNA	MII	Non MII
PLC Down	<b>Invalid</b>	<b>Valid</b>	<b>Invalid</b>	<b>Valid</b>	<b>Invalid</b>	N/A
PLC Routed	<b>Valid</b>	Valid	<b>Valid</b>	Valid	<b>Invalid</b>	N/A
PLC Not Routed	<b>Invalid</b>	Valid	<b>Invalid</b>	Valid	N/A	N/A
MII Down	Invalid	N/A	Invalid	N/A	Invalid	Valid
MII Routed	<b>Invalid</b>	N/A	Invalid	N/A	<b>Valid</b>	Valid
MII Not Routed	N/A	N/A	N/A	N/A	Invalid	Valid

### 11.2. USB Test Coverage Matrix

USB Combination Coverage Matrix

Motherboards	-----Risers-----	
	USB	Non USB
USB Not Routed	<b>Invalid</b>	Valid
USB 1.x Routed	<b>Valid</b>	Valid

### 11.3. AC Link Test Coverage Matrix

AC Link Combination Validity Matrix

Motherboards	-----Risers-----			
	Audio	Modem	Audio / Modem	AMC Stand alone or Upgrade
AC Link Routed, no codecs down	Valid	Valid	Valid	Valid
Audio Down	Valid <sup>1</sup> Upgrade	Valid	Invalid <sup>2</sup>	Valid <sup>2,1</sup> Upgrade
Modem Down	Invalid	Invalid	Invalid <sup>2</sup>	Invalid <sup>2</sup>
Audio & Modem Down	Invalid	Invalid	Invalid <sup>2</sup>	Invalid <sup>2</sup>
AMC Down	Valid <sup>1</sup> Upgrade	Invalid	Invalid <sup>2</sup>	Invalid <sup>2</sup>
AC Link Not Routed	Invalid	Invalid	Invalid	Invalid

- <sup>1</sup> - Valid Upgrade requires multi-channel signature support and matching codecs. 2 Channel Audio codecs are considered upgrades.
- <sup>2</sup> - Combinations may be supportable by the CNR specification but are invalid for test purposes since the combinations result in unusable connectors on the motherboard. i.e. A valid replacement CNR requires the down codecs and connectors to be disabled. 'Dead' connectors on motherboards are not acceptable for motherboard testing but are acceptable for riser testing. 4-6 Channel Audio risers, Audio/Modem Risers, and AMC risers can be considered replacements with denoted combinations.